PATENT SPECIFICATION

Convention Date (United States): June 19, 1937. **501,957**

Application Date (in United Kingdom): May 11, 1938. *No. 14069/38.*

Complete Specification Accepted: March 8, 1939.

COMPLETE SPECIFICATION

Improvement in Vibratory Electric Motor Apparatus

We, CLIPSHAVE, INC., a corporation organized under the laws of the State of New York, one of the United States of America, of 11, North Pearl Street, Port Chester, New York, United States of America (Assignee of JOHN AMBROSE HANLEY, of Garden City Road, Noroton, Connecticut, United States of America, a citizen of the United States of America), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

While the present invention is shown applied to an electric shaver, it is applicable also to a variety of other generally analogous apparatus, such as hair clippers, massaging devices and the like, and the vibratory motor incorporated therein is of general utility in other applications.

Among the objects of the invention are to provide an encased electric motor structure of low cost, suitable for a device of the above type which shall evolve high power for small bulk and shall have a minimum number of rugger parts correlated without resort to pivot screws or pins that are apt to come loose or out of alignment and which can accordingly be assembled easily and economically.

Another object is to provide a device of the above type which, in addition to the primary cutting action in the shaving embodiment, inherently performs a vigorous vibrating or massaging action that promotes the shearing, shaving or clipping action.

According to the present invention the vibratory electric motor particularly applicable to electric shavers, hair clippers, massaging apparatus and the like, comprises an electro-magnetic field structure and an armature extending at one point into a coil carried by the field structure, the armature engaging with the field structure within said coil by means of a thrust bearing constituted by a peak on one of the parts and a conforming trough in the other, means also being provided resiliently to oppose the separation of the armature from the field structure at the thrust bearing.

Vibratory electric motors in which the armature engages with the field structure by means of a thrust bearing constituted by a peak on one part and a conforming trough on the other part with means resiliently opposing the separation of the parts at the thrust bearing are already known. In such prior proposals, however, the thrust bearing was located outside the coil. By having the thrust bearing inside the coil as in the present invention there is a minimum magnetic loss.

In the accompanying drawings in which is shown one of various possible embodiments of the several features of the invention,

Fig. 1 is a plan view of the device with the cover removed and parts shown in section, better to reveal the details of construction,

Fig. 2 is a view in longitudinal section taken on line 2—2 of Fig. 1,

Figs. 3 and 4 are views in transverse section taken respectively on lines 3—3 and 4—4 of Fig. 1,

Fig. 5 is a perspective view of the armature unit, and

Fig. 6 is a fragment of a view similar to Fig. 1 showing a modification.

Referring now to the drawings there is shown an insulating casing involving a base 10 and cover 11 serving as the handle for the electrically driven shaver or other tool and housing the vibratory electric motor. The motor comprises a generally rectangular open soft iron magnetic frame including a fixed field structure 12 and a movable armature 13. The field structure is made up of a stack of generally **U**-shaped laminations 12^1 secured to the floor of the casing by a pairs of screws 14 threaded into metal nuts or sockets 15 preferably molded into the base of the casing. The armature 13 is made up of a stack of generally **L**-shaped laminations 13^1 held together by rivets 16. The armature is not positively secured with respect to the field structure but has a rocking thrust bearing engagement at the toe end of the **L** with the end of one leg of the **U**-shaped field structure. In a preferred construction of such thrust bearing the

toe of the L-shaped armature has an obtuse dihedral angular extension or peak 17 lodged in an obtuse dihedral angular depression 18 of wider angularity, in the end of the field leg 19. The outer leg 20 of the field structure is longer than leg 19 so that the length of the armature which extends transversely thereacross is in contiguity thereto.

A spring, preferably an elliptic leaf spring 21 is hooked at its extremities to anchoring lugs 22 and 23 that are stamped integrally with the shorter legs of the laminations making up the field and armature structures. The spring 21 draws the armature against the field structure and maintains the left oblique walls of the respective trough and peak as shown in Fig. 1, in face-to-face engagement, with the apex *a* of said peak in the angle of the trough 18. and a small angular gap 25 exists between the corresponding right sides of the dihedral angles. Spring 21 is free from engagement with the motor and casing, except at its anchored extremities, so that it may vibrate without obstruction in motor operation.

Electromagnet spools 26 and 27 encircle the respective legs 19 and 20 of the field structure and are lodged against movement in corresponding depressions in the floor of the casing as appears best from Figs. 3 and 4. The spools are connected in series by lead 28. and the leads 29 and 30 therefrom are attached to terminal screws 31 and 32. respectively, which have electrical and mechanical contact with metal stampings 33 that protrude through the molded flexible rubber bushing 34 within which they are connected to the conductor elements of the cord set 35. The bushing 34 is rectangular in form and fits in corresponding rectangular recesses 37. respectively. in the casing 10 and the cover 11 thereof.

An intermediate lamination 13*a* of the armature, as best shown in Fig. 5 preferably of greater thickness than the other laminations is elongated and conformed to extend about the spool 27 as at 41 to serve as the tool operating arm 40 which protrudes centrally outward through a port 42 in the forward end of the casing for coaction, in the electric shaver embodiment, with a movable blade 43 to be oscillated thereby for performing the shearing action. Blade 43 coacts with a fixed blade 44 which may be mounted on studs 45 molded into the end of the casing. An open rectangular metal clamp structure 46 engages the ends of the blade assembly and snaps over lateral inwardly inclined lugs 47 molded as part of the casing. The structure of the cutter illustratively shown, need not be more fully described as it is not *per se*, the subject of the present application.

A cushion 50 comprising a generally rectangular block of resilient rubber is centrally perforated at 51 to encircle the extension arm 40 of the armature and is lodged against corresponding shoulders in the casing and its cover, the latter compressing said resilient rubber block snugly to embrace the operating arm 40. Shoulders 52 on the operating arm 40 engage rubber block 50 and help to keep it in place.

The cover 11 at the rear end is as deep as the casing 10, the rear walls of said elements affording complementary notches snugly to embrace the neck 53 of the resilient bushing 34. The casing 10 and the cover 11 also have integral studs 54 and 55, respectively, lodged in corresponding grooves 56 in bushing 34. Studs 54 and 55 are perforated to accommodate a fastening screw 57 threaded into a socket or nut 58 molded into the base of stud 54. The lateral casing walls 59 extend obliquely upward from the rear and the lateral walls of the cover extend correspondingly obliquely to narrow to a relatively sharp forward edge 60 to the rear of the tool mounting end of the casing. A pair of shorter cover fastening screws 61 laterally of the cushion 50 are threaded into corresponding sockets or nuts 62 molded into the casing.

In operation. alternations in the magnetization of the soft iron frame 12, 13 will occur with a frequency corresponding to that of the source of current. As the magnetization reaches a maximum the armature 13 will be attracted by rocking about the apex of peak 17 toward the right, against the resistance of spring 21 as well as against the resistance of resilient cushion 50, both of which stressed elements conjointly help promptly to return the armature to the position shown in Fig. 1 upon demagnetization in the course of each reversal of current phase. Thus on a 60 cycle circuit the motor armature will perform 7200 oscillations per minute and the shearing plate 43 or corresponding tool element will be oscillated at that rate.

The cushion 50 performs the combined functions of preventing contact between the operating arm 40 and the casing, of preventing complete closure of gap 25, and of imposing a resilient load on the armature, thereby storing energy which acts to bias the armature to return after each magnetic impulse. The spring 21 acts conjointly with the cushion 50 in imposing a resilient load, and releasing its stored energy for armature return, and in addition it keeps the apex *a* of the arma-

ture against the end of the field structure throughout operation and thus prevents the possibility of chattering or clattering at the magnetic thrust bearing and assures smoothness of the rocking action set forth. The motor therefore operates with a sustained constant speed corresponding to the frequency of the operating current.

It will be seen that the armature is of floating character, since at all stages of its rocking movement, it engages and is resisted both by the spring 21 and the cushion 50. There is no lost motion and the impact which would result were there any lost motion, is avoided. The bearing 17—18 constitutes a magnetic pivot, which affords at all times a continuous iron circuit for the magnetic flux, for which reason magnetic losses are minimized and there is a minimum of mechanical friction.

The operation of the motor is such that the entire casing is caused to vibrate forcefully in the hand, and thereby, in addition to the cutting action by the sliding of the movable blade 43 relatively to the fixed blade 44, the entire unit oscillates vigorously at a frequency corresponding to that of the motor actuating current. A mechanical massaging action is accordingly imparted to the skin while the shaving proceeds, with the beneficial results commonly attributed to such action. By this operation discomfort to the skin in shaving is avoided as the hair is more readily caused to enter between the teeth of the cutter, and the ejection of the clippings is also facilitated by such vibration. Therefore the ease of shaving is enhanced as compared to a corresponding instrument operated from a rotary armature and devoid of the vibratory action set forth.

The construction is seen to be of extreme simplicity, with no rotary bearings and with the elimination of the need for precision of manufacture and adjustment that such bearings require. There is also the elimination of all circuit interrupters and associated arc quenchers and the disturbing effect of said interrupters on radio receivers is obviated. The motor being self-starting, the starting wheel or roller of conventional electric shavers is also eliminated. The few rugged parts making up the assembly are readily put together without the need for skilled workmanship.

In the embodiment of Fig. 6, the leaf spring 21 is replaced by a cushion comprising a soft rubber block 70 carried in a cradle 71 affixed to an extension 72 of the armature beyond the thrust bearing element 17^1 thereof. Rubber block 70 reacts against a ledge 73 in the casing 10. Accordingly, in operation, the cushion 70 is compressed and stores energy as the armature when attracted by the field structure rocks clockwise about pivot 17^1. The stressed rubber block 70 upon demagnetization of the magnetic frame therefor helps to return the armature to position corresponding to that of Fig. 1, and performs all the other functions of spring 21.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A vibratory electric motor particularly applicable to electric shavers, hair clippers, massaging apparatus and the like, comprising an electro-magnetic field structure, and an armature extending at one point into a coil carried by said field structure, the armature engaging with the field structure within said coil by means of a thrust bearing constituted by a peak on one of the parts and a conforming trough in the other, means also being provided resiliently to oppose the separation of the armature from the field structure at the thrust bearing.

2. A vibratory electric motor according to Claim 1, in which the peak and trough are of dihedral form and the trough is of greater angularity than the peak.

3. A vibratory electric motor according to claim 1 or 2, having a spring engaging the armature to resiliently oppose separation thereof from the field structure.

4. A vibratory electric motor according to claim 1 or 2, having a cushion engaging the armature to resiliently oppose separation thereof from the field structure.

5. A vibratory electric motor according to any of claims 1 to 4, in which the armature has a projecting tool-operating arm extending through a compressible cushion.

6. A vibratory electric motor, substantially as set forth and as illustrated in the accompanying drawing.

Dated this 11th day of May, 1938.
LESLIE N. COX,
Patent Agent,
408/9, Bank Chambers,
29, Southampton Buildings,
London, W.C.2,
Agent for the Applicants.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.

[This Drawing is a reproduction of the Original on a reduced scale.]